Freshwater on Guam: Impacts and Adaptive Response to Climate Change for Department of Defense Installations

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www.PacificRISA.org

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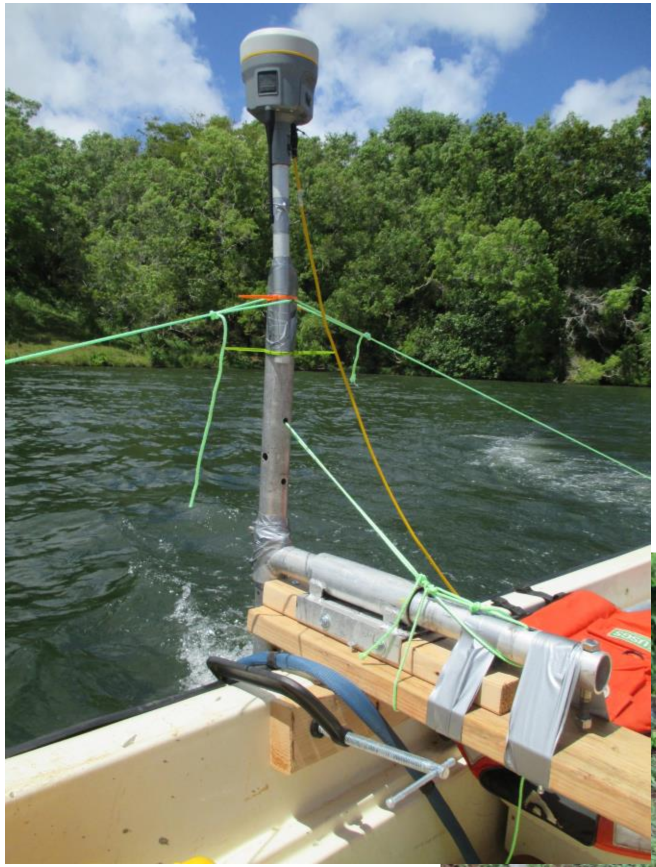
Use-Inspired Climate Research for Freshwater Security

- What is the impact of sea-level rise and a changing climate on freshwater availability in Guam?
  - How will proposed military relocation impact freshwater supply?
  - Historic information, sea-level rise predictions, and global climate model temperature and precipitation output
- Collaborations and Stakeholders
  - NAVFAC Marianas and Fena Reservoir, AAFB, GovGuam, OneWater Guam, Guam Waterworks Authority



Bathymetric survey of the Fena Reservoir, 2015

USGS Groundwater survey, 2015

Climate Impacts on Guam

- 85 to 116" inches of rain a year, two-thirds during the rainy season
- Freshwater sources: Fena Reservoir (DoD), Northern Guam Lens Aquifer (NGLA), surface water (southern Guam)
- Climate impacts: Drought, flood, wildfire, heat, tropical storms/typhoons
- Threats: Over-pumping wells, land degradation, flooding, erosion and sediment, sea level rise, increased population and demand

Guam PIRCA, 2020. Map by L. Brewington

Future (2080-99) Climate Projections

- Future scenarios provide a range to plan for depending on a system's risk tolerance
- Average annual air temperature on Guam is projected to be 5.8°F warmer
- Increase in "very hot days" (>90°F) to 257 days a year
- Projected average annual rainfall will be about 7% lower
- Increased drought of 4/10 years

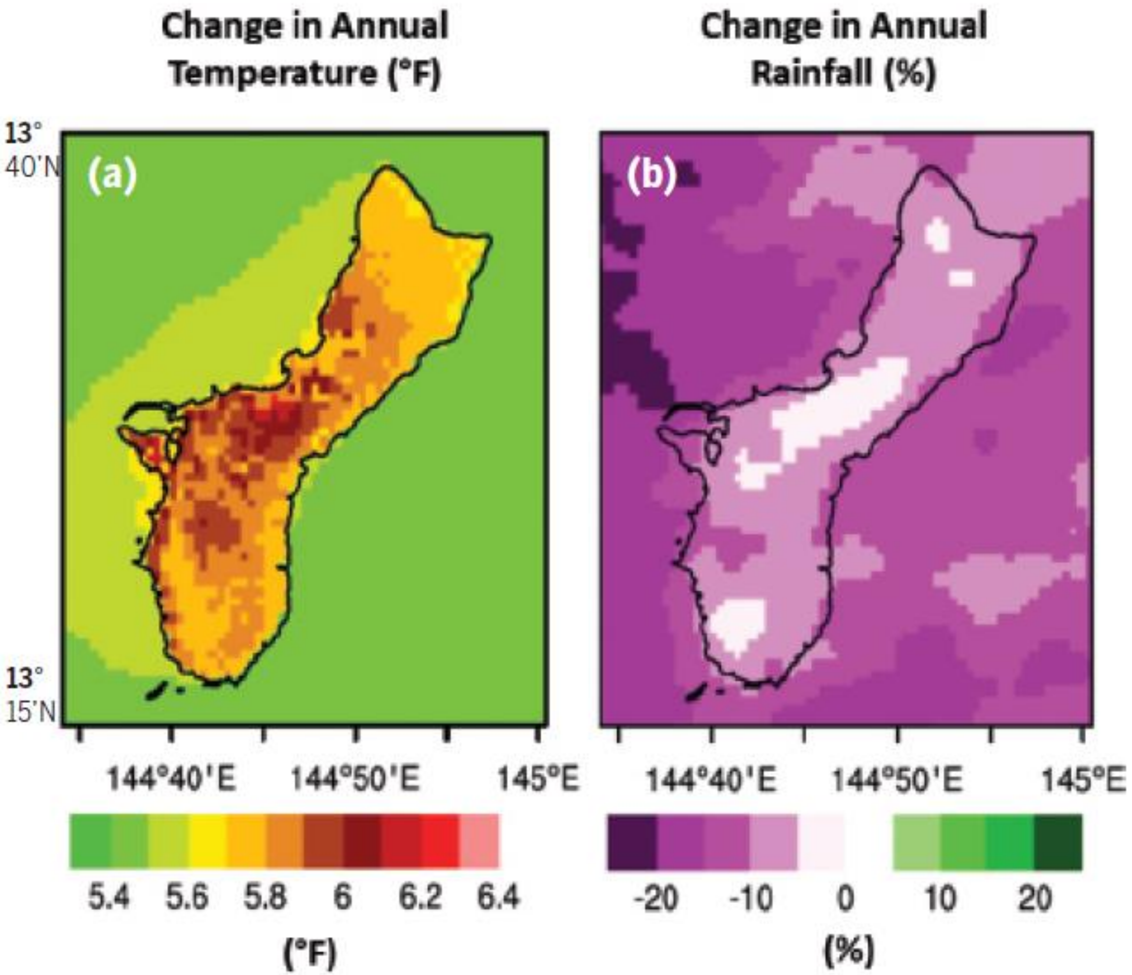


Figure 1. Projected changes in average annual (a) temperature (°F) and (b) rainfall (% change) in 2080–99 using warming scenario RCP8.5 ("business-as-usual"), as compared to the 1990–2009 baseline[11].

Gingerich et al 2019 ; Keener et al, 2019

Impacts on Freshwater Supply and Planning Scenarios

- -18% annual average streamflow in southern Guam, +14% ET
- Higher costs of treating surface water
- -19% mean annual recharge for NGLA
- Little impact of SLR, even up to 6.6 ft
- Iterative discussions with stakeholders provided key drought, groundwater management, and educational scenarios for management

Briefing to DoD and GovGuam Stakeholders

Generate Adaptive Management Strategies

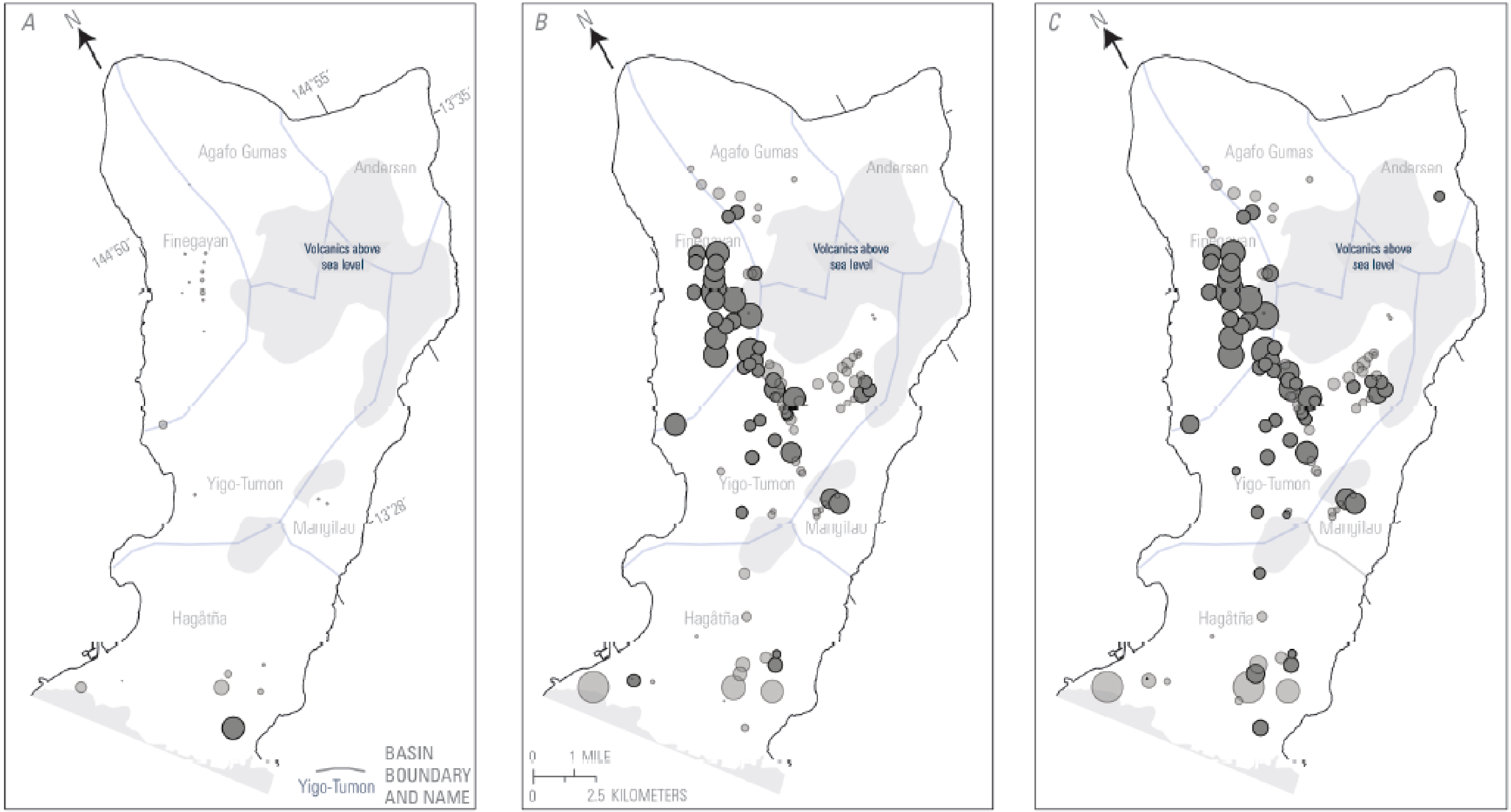
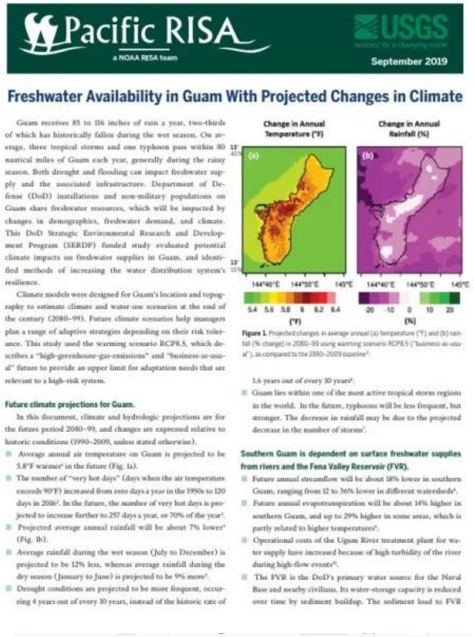
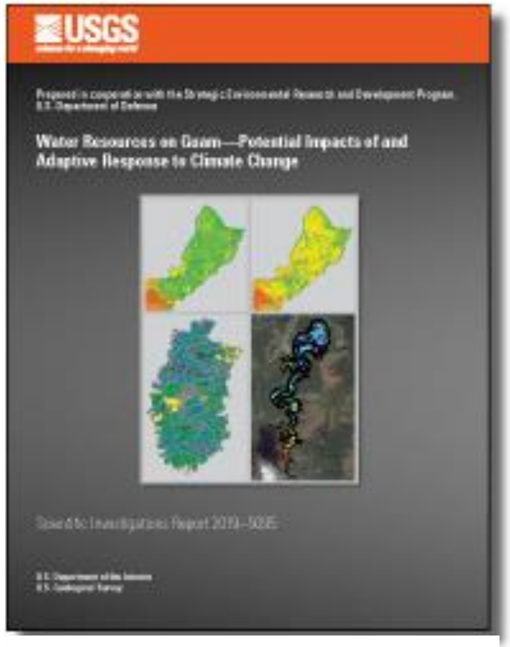


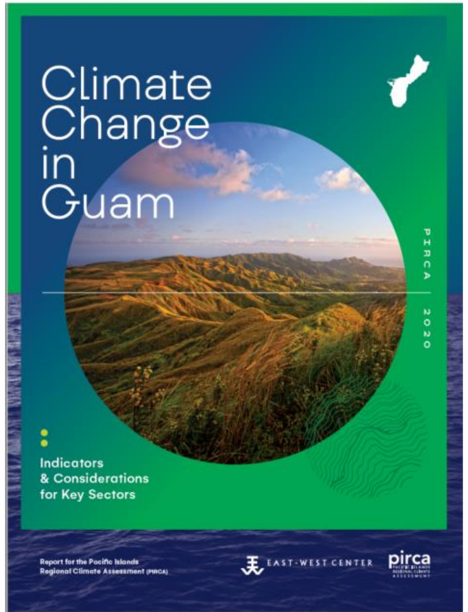
Figure 3. Withdrawal wells with simulated salinity increases for future conditions in the Northern Guam Lens Aquifer for (a) 6.6-ft higher sea level, (b) 19% lower recharge, and (c) 3.3-ft higher sea level and 19% lower recharge. Wells shown in dark gray are those that have chloride-concentration increases large enough to move into a higher concentration category as indicated in the figure legend[16].

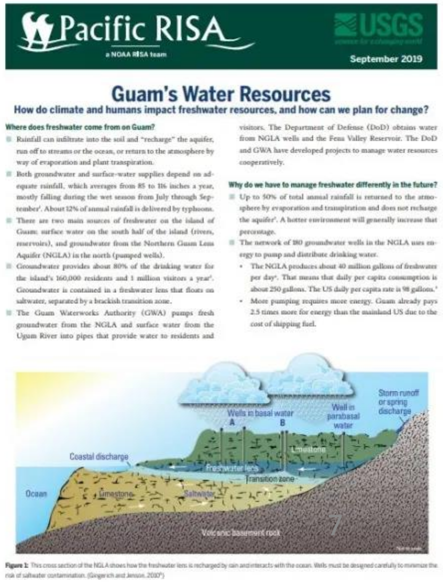
Informing Policy and Management

- Summary, resources, and data available at: *www.pacificrisa.org/projects/water/guam-serdp/*
  - Drought and pumping scenarios
- Briefing sheets for managers and educators
- PIRCA: Climate Change in Guam: Indicators and Considerations for Key Sectors (November 2020)
- Freshwater resources legislation
- Guam Climate Commission









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